RATE CONTROL DEVICE AND METHOD FOR CDMA COMMUNICATION SYSTEM

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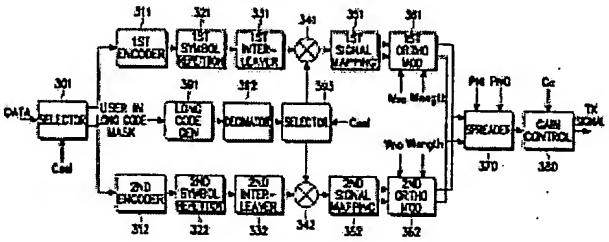
Abstract of **WO9945660**

A traffic channel transmission device for a CDMA communication system using a plurality of coding rates and orthogonal codes, determines a present channel condition and adaptively selects a coding rate and an orthogonal code according to the determination. In the device, a channel receiver receives a channel signal and a controller analyzes the received signal to decide an environment of a channel in service and generates a coding rate select signal and orthogonal code information according to the decision result. A channel transmitter includes a channel encoder (311, 312) for encoding transmission data at a coding rate selected according to the coding rate select signal (Csel) and an orthogonal modulator (361, 362) for generating an orthogonal code according to the orthogonal code information to spread the encoded data with the generated orthogonal code, whereby the channel transmitter adaptively encodes and spreads the transmission data according to the channel environment. The orthogonal code information includes a number and a length of the orthogonal code.



RATE CONTROL DEVICE AND METHOD FOR CDMA COMMUNICATION SYSTEM

Claims of **WO9945660**

WHAT IS CLAIMED IS:

1. A channel communication device for a code division multiple access (CDMA) communication system, comprising:
a channel receiver for receiving a channel signal;
a controller for analyzing the received signal and/or transmitting condition to decide an environment of a channel in service, and generating a coding rate select signal and orthogonal code information according to the decision result; and
a channel transmitter including a channel encoder for encoding transmission data at a coding rate selected according to the coding rate select signal and an orthogonal modulator for generating an orthogonal code according to the orthogonal code information to spread said encoded data with the generated orthogonal code, whereby the channel transmitter selectively encodes and spreads the transmission data according to the channel environment.

2. The channel communication device as claimed in claim 1, wherein said controller measures at least one of a receiving power, interference, a bit error rate (BER) and a signal-to-noise ratio (SNR) from the received signal, compares the measured values with corresponding upper threshold values to generate the coding rate select signal for decreasing the coding rate and the orthogonal code information for reducing a length of the orthogonal code when the measured values exceed the upper threshold values, and compares the measured values with corresponding lower threshold values to generate the coding rate select signal for increasing the coding rate and the orthogonal code information for increasing the length of the orthogonal code when the measured values are below the lower threshold values.

3. The channel communication device as claimed in claim 1, wherein said channel transmitter comprises:
at least two channel encoders each having different coding rates, for encoding an input transmission signal at the corresponding coding rate;
interleavers in the same number as that of the channel encoders, for interleaving the corresponding encoded data by a frame unit;
selectors for selectively connecting the input transmission signal to the channel encoders according to the coding rate select signal;
an orthogonal modulator for generating the orthogonal code corresponding to the orthogonal code information and spreading the encoded data output from the selected interleaver with the generated orthogonal code; and
a pseudo-random noise (PN) spreader for PN spreading the orthogonal spread signal.

4. The channel communication device as claimed in claim 3, wherein said orthogonal code information includes a number and a length of the orthogonal code.

5. A channel reception device for a mobile station in a CDMA communication system, comprising:
a PN despreader for PN despreading a received signal;
an orthogonal demodulator for generating an orthogonal code corresponding to orthogonal code information transmitted from a base station, and orthogonally despreading the PN despread signal with the generated orthogonal code; and
a receiver including deinterleavers and channel decoders corresponding to at least two rates, wherein the corresponding deinterleaver deinterleaves the orthogonally despreaded signal and the corresponding channel decoder decodes the deinterleaved signal according to a coding rate select signal transmitted from the base station.

6. The channel reception device as claimed in claim 5, wherein said receiver comprises:
deinterleavers provided in the same number as that of the rates, for deinterleaving the orthogonally despreaded signal;
at least two channel decoders having different rate, for decoding the deinterleaved signal; and
selector for selectively connecting the orthogonally despreaded signal to the deinterleaver having the corresponding rate and selectively outputting an output of the channel decoder having the corresponding rate according to the coding rate select signal transmitted from the base station.

7. A channel communication device for a CDMA communication system using multiple carriers, comprising:
a channel receiver for receiving a channel signal;
a controller for analyzing the received signal and/or transmitting condition to decide an environment of a channel in service, and generating a coding rate select signal and orthogonal code information according to the decision result; and
a channel transmitter including a channel encoder for encoding
transmission data at a coding rate selected according to the coding rate select
signal and, orthogonal modulators in the same number as that of the carriers, for
generating orthogonal codes according to the orthogonal code information to
spread the encoded data with the generated orthogonal codes, respectively, whereby the channel transmitter selectively controls the coding rate and the orthogonal spreading according to an environment of the channel in service.

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8. The channel communication device as claimed in claim 7, wherein said controller measures at least one of a receiving power, interference, a bit error rate (BER) and a signal-to-noise ratio (SNR) from the received signal, compares the measured values with corresponding upper threshold values to generate the coding rate select signal for decreasing the coding rate and the orthogonal code information for reducing a length of the orthogonal code when the measured values exceed the upper threshold values, and compares the measured values with corresponding lower threshold values to generate the coding rate select signal for increasing the coding rate and the orthogonal code information for increasing the length of the orthogonal code when the measured values are below the lower threshold values

9. The channel communication device as claimed in claim 7, wherein said channel transmitter comprises:
at least two channel encoders each having different coding rates, for encoding an input transmission signal at the corresponding coding rate;
interleavers for interleaving the encoded data output from the respective channel encoders, respectively;
selectors for selectively connecting the input transmission signal to the channel encoder having the corresponding coding rate according to the coding rate select signal;
a demultiplexer fordemultiplexing the interleaved data output from the selectors to the respective carriers;
orthogonal modulators in the same number as that of the carriers, for generating the orthogonal code corresponding to the orthogonal code information and spreading the encoded data output from the demultiplexer with the generated orthogonal code; and
transmitters for PN spreading the orthogonal spreaded signals and transmitting the PN spreaded signals by carrying them on the corresponding carriers, respectively.

10. The channel communication device as claimed in claim 9, wherein said orthogonal code information includes a number and a length of the orthogonal code.

11. The channel communication device as claimed in claim 9, wherein said demultiplexer uniformly distributes the encoded data to the respective carriers.

12. A channel communication method for a CDMA communication system, comprising the stepsof :
analyzing an environment of a channel in service, and selecting required coding rate and orthogonal code when the channel environment satisfis a rate change condition;
generating a message including information about the selected coding rate and orthogonal code and sending the message to a mobile station; and
upon reception of a response message from the mobile station after sending the message, switching a coding rate and an orthogonal code, presently in use, of a channel transmitter to the selected coding rate and orthogonal code.

13. The channel communication method as claimed in claim 12, wherein said selection step comprises the stepsof :
examining a channel condition with the mobile station to determined whether the rate change condition is satisfied;
selecting a coding rate lower than a present coding rate and selecting an orthogonal code having a length corresponding to the selected coding rate, when a first rate change condition is satisfied; and
selecting a coding rate higher than a present coding rate of the mobile station and selecting an orthogonal code having a length corresponding to the selected coding rate, when a second rate change condition is satisfied

14. The channel communication method as claimed in claim 13, wherein the first rate change condition is satisfied when a transmission power to the mobile station is higher than an average transmission power of all the mobile stations presently in service and there are available orthogonal codes corresponding to the selected coding rate.

15. The channel communication method as claimed in claim 14, wherein said average transmission power is obtained by subtracting a power margin from a maximum transmission power of the base station and then dividing the subtracted power value by the number of the mobile stations presently in service.

16. The channel communication method as claimed in claim 13,wherein said orthogonal code selection step comprises the steps of :
selecting a length of an orthogonal code corresponding to a coding rate,
and selecting unused orthogonal codes among the orthogonal codes having the
selected length;
examining anon-orthogonality between the selected orthogonal codes and orthogonal codes longer than the selected orthogonal codes and excluding orthogonal codes unsatisfying an orthogonality therebetween;
determining whether complementary orthogonal codes of the orthogonal codes remaining after exclusion are in use or not;
assigning one of the orthogonal codes whose complementary orthogonal codes are in use;
when the complementary orthogonal codes corresponding to the orthogonal codes remaining after the exclusion are all not in use, examining the non-orthogonality between the remaining orthogonal codes and orthogonal codes shorter than the remaining orthogonal codes and excluding the orthogonal codes unsatisfying the orthogonality therebetween; and
assigning one of the orthogonal codes remaining after the exclusion.

17. The channel communication method as claimed in claim 13, wherein the first rate change condition is satisfied when a transmission power to the mobile station is higher than an average transmission power of all the mobile stations presently in service, there are available orthogonal codes corresponding to the selected coding rate, a receiving strength of a reverse link is lower than a reference strength value, and a signal-to-noise ratio of the reverse link is lower than a reference signal-to-noise ratio.

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18. The channel communication method as claimed in claim 13, wherein the second rate change condition is satisfied when a transmission power to the corresponding mobile station is lower than a reference average transmission power to the other mobile stations.

19. The channel communication method as claimed in claim 13, wherein the second rate change condition is satisfied when a transmission power to the corresponding mobile station is lower than a reference average transmission power to the other mobile stations, a receiving strength of a reverse link is higher than a reference strength value, and a signal-to-noise ratio of the reverse link is higher than a reference signal-to-noise ratio.

20. A channel communication method for a CDMA communicationsystem, comprising the steps of :
upon reception of a rate change request message from a mobile station, selecting a coding rate according to the received message and determining whether there exist available orthogonal codes corresponding to the selected coding rate;
generating a response message including information about the selected coding rate and orthogonal code and sending the generated message to the corresponding mobile station; and
switching the present coding rate and orthogonal code of a channel transmitter to the selected coding rate and orthogonal code.

21. The channel communication method as claimed in claim 20,wherein said selection step comprises the steps of :
examining a channel condition with the mobile station to determined whether the rate change condition is satisfied;
selecting a coding rate lower than a present coding rate of the mobile station and selecting an orthogonal code having a length corresponding to the selected coding rate, when a first rate change condition is satisfied; and
selecting a coding rate higher than a present coding rate of the mobile station and selecting an orthogonal code having a length corresponding to the selected coding rate, when a second rate change condition is satisfied
22. The channel communication method as claimed in claim21, wherein the first rate change condition is satisfied when a transmission power to the mobile station is higher than an average transmission power of all the mobile stations presently in service and there are available orthogonal codes corresponding to the selected coding rate.

23. The channel communication method as claimed in claim 22, wherein said average transmission power is obtained by subtracting a power margin from a maximum transmission power of the base station and then dividing the subtracted power value by the number of the mobile stations presently in service.

24. The channel communication method as claimed in claim21, wherein said orthogonal code selection step comprises the steps of :
selecting a length of an orthogonal code corresponding to a coding rate, and selecting unused orthogonal codes among the orthogonal codes having the selected length;
examining a non-orthogonality between the selected orthogonal codes and orthogonal codes longer than the selected orthogonal codes and excluding orthogonal codes unsatisfying an orthogonality therebetween;
determining whether complementary orthogonal codes of the orthogonal codes remaining after exclusion are in use or not;
assigning one of the orthogonal codes whose complementary orthogonal codes are in use;
when the complementary orthogonal codes corresponding to the orthogonal codes remaining after the exclusion are all not in use, examining the non-orthogonality between the remaining orthogonal codes and orthogonal codes shorter than the remaining orthogonal codes and excluding the orthogonal codes unsatisfying the orthogonality therebetween; and
assigning one of the orthogonal codes remaining after the exclusion.

25. The channel communication method as claimed in claim 21, wherein the first rate change condition is satisfied when a transmission power to the mobile station is higher than an average transmission power of all the mobile stations presently in service, there are available orthogonal codes corresponding to the selected coding rate, a receiving strength of a reverse link is lower than a reference strength value, and a signal-to-noise ratio of the reverse link is lower than a reference signal-to-noise ratio.

26. The channel communication method as claimed in claim 21, wherein the second rate change condition is satisfied when a transmission power to the corresponding mobile station is lower than a reference average transmission power to the other mobile stations.

27. The channel communication method as claimed in claim21, wherein the second rate change condition is satisfied when a transmission power to the corresponding mobile station is lower than a reference average transmission power to the other mobile stations, a receiving strength of a reverse link is higher than a reference strength value, and a signal-to-noise ratio of the reverse link is higher than a reference signal-to-noise ratio.

28. A channel communication method for a CDMA communicationsystem, comprising the steps of :
analyzing an environment of a channel in service to determine whether a rate change condition is satisfied, and sending a rate change request message to a base station when the rate change condition is satisfied; and
upon reception of a response message from the base station after sending the message, switching a coding rate and an orthogonal code, presently in use, of a channel receiver to a decoding rate and a despreading orthogonal code corresponding to information included in the response message.

29. The channel communication method as claimed in claim 28,wherein said rate change condition determination step comprises the steps of :

examining an environment of a channel in communication with the base station;
selecting a coding rate lower than a present coding rate, when a first rate change condition is satisfied; and
selecting a coding rate higher than a present coding rate, when a second rate change condition is satisfied

30. The channel communication method as claimed in claim 29, wherein the first rate change condition is satisfied when at least one of the following conditions is satisfied:
condition 1: an average reverse link transmission power is higher than an upper threshold transmission power;
condition 2: an average forward link receiving strength is lower than a lower threshold receiving strength; and
condition 3: an average forward link signal-to-noise ratio is lower than a lower threshold signal-to-noise ratio.

31. The channel communication method as claimed in claim 29, wherein the second rate change condition is satisfied when at least one of the following conditions is satisfied:
condition 1: an average reverse link transmission power is lower than a lower threshold transmission power;
condition 2: an average forward link receiving strength is higher than an upper threshold receiving strength; and
condition 3: an average forward link signal-to-noise ratio is higher than an upper threshold signal-to-noise ratio.

32. A channel communication method for a CDMA communication system, comprising the stepsof:
upon reception of a rate change request message from a base station, selecting a coding rate and an orthogonal code according to information included in the request message and sending a response message to the base station; and
changing a decoding rate and a despreading orthogonal code, presently in use, of a channel receiver to the selected coding rate and orthogonal code.

33. A channel communication method for a CDMA communication system, comprising the stepsof:
upon reception of a rate change request message from a base station, determining whether it is possible to change present decoding rate and a despreading orthogonal code to a coding rate and an orthogonal code corresponding to information included in the request message;
generating and sending a response message to the base station and changing the present decoding rate and orthogonal code to the decoding rate and a despreading orthogonal code corresponding to information included in the request message, when it is possible to change the present coding rate and orthogonal code; and
generating and sending a message representing impossibility of the rate change to the base station, when it is impossible to change the present coding rate and orthogonal code.

34. A channel communication method for a CDMA communicationsystem, comprising the steps of:
selecting a length of an orthogonal code corresponding to a coding rate, and selecting unused orthogonal codes among the orthogonal codes having the selected length;
examining a non-orthogonality between the selected orthogonal codes and orthogonal codes longer than the selected orthogonal codes and between the selected orthogonal codes and orthogonal codes shorter than the selected orthogonal codes, and excluding orthogonal codes unsatisfying an orthogonality therebetween from the selected orthogonal codes; and
assigning one of the orthogonal codes remaining after exclusion.

35. A channel communication method for a CDMA communicationsystem, comprising the steps of:
selecting a length of an orthogonal code corresponding to a coding rate, and selecting unused orthogonal codes among the orthogonal codes having the selected length;
examining a non-orthogonality between the selected orthogonal codes and orthogonal codes longer than the selected orthogonal codes and excluding orthogonal codes unsatisfying an orthogonality therebetween;
determining whether complementary orthogonal codes of the orthogonal codes remaining after exclusion are in use or not; and
assigning one of the orthogonal codes whose complementary orthogonal codes are in use.

36. The channel communication method as claimed in claim35,
N wherein said complementary orthogonal code is determined by (i+ 2) mod N (wherei is an orthogonal code number and N is an orthogonal code length.

37. The channel communication method as claimed in claim 35,further comprising the steps of:
when the complementary orthogonal codes corresponding to the orthogonal codes remaining after the exclusion are all not in use, examining the non-orthogonality between the remaining orthogonal codes and orthogonal codes shorter than the remaining orthogonal codes and excluding the orthogonal codes unsatisfying the orthogonality therebetween; and assigning one of the orthogonal codes remaining after the exclusion.
